ESO 1388

COSTS OF PRODUCING

FIELD ORNAMENTAL TREES IN OHIO

By

Reed D. Taylor, Harold H. Kneen, Elton M. Smith,

David E. Hahn, Stanley Uchida*

Department of Agricultural Economics
And Rural Sociology
The Ohio State University
Columbus, Ohio 43210

*Associate Professor, and Graduate Student, Department of Agricultural Economics and Rural Sociology; Professor, Department of Horticulture; Professor, and Graduate Student, Department of Agricultural Economics and Rural Sociology. Mr. Kneen is presently Director of Marketing, Studebaker Nurseries, Inc., New Carlisle, Ohio. Mr. Uchida works for BANCOHIO, Columbus, Ohio

September 15, 1987

Costs of Producing Field Ornamental Trees in Ohio

Reed D. Taylor, Harold H. Kneen, Elton M. Smith,
David E. Hahn and Stanley Uchida*

ABSTRACT

The objective of this study was to determine annual production costs for field-grown ornamental trees in Ohio in firms of two sizes. This objective was accomplished by synthesizing two model field nurseries using an economic engineering approach. Once the nurseries were simulated, growing space was divided into five equal parts with each segment being assigned a plant group. In the 50-acre nursery, ornamental trees were allocated 8 acres of growing space and in the 200-acre nursery 35 acres. One species of ornamental tree (Malus) was chosen for detailed analysis.

---

*Associate Professor, and former Graduate Student, Dept. of Agricultural Economics and Rural Sociology, Professor, Dept. of Horticulture, Professor, and former Graduate Student, Dept. of Agricultural Economics and Rural Sociology. Mr. Kneen is presently Director of Marketing, Studebaker Nurseries, Inc., New Carlisle, Ohio. Mr. Uchida works for BANCOHIO, Columbus, Ohio.

Drs. Taylor, Smith, and Hahn also have appointments in the Ohio Cooperative Extension Service.

In the space allocated, 2,732 Malus of 5-6 foot tall (1-1/2 inch caliper) could be produced annually in the 50-acre nursery and 11,954 in the 200-acre. Based on 1985 figures, total costs per salable plant were $36.82 in the 50-acre nursery and $24.73 in the 200-acre.

INTRODUCTION

Ornamental trees, including various species of Malus, and Prunus are important in Ohio. As a group they encompass a wide range of growing habits, size, foliage, flower, and fruit colors and they can be effectively used in many ways in landscaping.

The specific objective of this study was to determine annual production costs for ornamental trees grown in the field by two sizes of firms. This information should aid Ohio nurserymen in their decisions regarding which plants to grow and in what quantities.

MATERIALS AND METHODS

Two model firms were synthesized in the study using the conceptual framework of economic engineering wherein the 'best proven practice' was included in each model. The analysis is based on conditions in Central Ohio. The complete synthesis included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation systems; lists of equipment and other items; a complete sequence by month and year of nursery operational steps

beginning with propagation and ending with loading the finished product for wholesale distribution; and budgets for fixed and variable costs.

Data for this study were obtained from wholesale nurseries and nursery suppliers in Ohio during 1985. The basic goals in simulating the production facilities were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, and initial investment, and to maximize the number of salable plants and keep future expansion possible. See Taylor et al. (1) for a detailed analysis of the physical plant, production system, and capital production budgets.

In the production cycle, two-year old purchased liners were prepared and planted directly into the field. Approximately 25% of the crop will be harvested and sold during the fall of the third field production year and another 25% dug, overwintered (heeled in with wood chips), and sold during late Winter and early Spring of the fourth field production year. The remaining 50% of the crop will be harvested and sold during late Winter and Spring of the fourth field production year. After the harvest is complete, the land is left fallow and disked for weed control four times during summer months. The fields are plowed in the fall of the fourth field production year in preparation for spring planting.

A model facility was synthesized for both a 50-acre and a 200-acre field nursery. The nursery operations were assumed to produce a diverse line of nursery stock, each having its own

unique production cycle. Commonly grown nursery stock was divided into five groups. While not all inclusive, the groups do permit developing a range of per unit costs related to input costs and cultural factors. It was assumed that each plant group would occupy 20% of the field growing area (i.e. 50-acre nursery = 8 acres per group, 200-acre nursery = 35 acres per group. In addition to the field growing area, the 50-acre nursery had 10 acres and the 200-acre nursery 25 acres of production facilities including overwintering houses, propagation facilities, shipping area, holding area, liner bed area, pond, supply shed, machinery storage, machine shop, office, and rest rooms. Costs developed on ornamental trees (Malus) therefore were based on the scale of complete nurseries, but were analyzed on the basis of percent of total space occupied. Companion studies were reported in the 1987 issue of "Ornamental Plants" (2). Fixed costs were reported beginning on page 26, costs for slow growing evergreens (page 37), deciduous shrubs (page 45), and costs for shade trees (page 51). In this publication costs for rapid-growing evergreens are reported beginning on page ____. For detailed analysis on ornamental trees, one specific plant species of (Malus) was chosen, While it is recognized that other ornamental trees (Prunus) would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the Malus analyzed.

Costs were calculated for all factors of production including management and invested capital. In economic terms,

costs associated with factors of production supplied by owner/operators are often referred to as 'opportunity costs' or the income these factors could have received if they were employed elsewhere. For example, owners could usually be employed as managers at other nurseries, and money invested inland, buildings, irrigation systems, and equipment could have earned interest if it had been placed in financial institutions.

Capital requirements for establishing the nurseries were first determined (1). Second, capital requirements per salable plant capacity by size of nursery were established (1). Third, annual fixed costs were calculated (1). Fourth, annual variable costs were determined for each of the two sized nurseries (Tables 1 and 2). Fifth, summaries were made for annual fixed and variable costs according to size of nursery (Table 3). This allowed cost comparisons based on size of nursery.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis. This approach does not give a true economic picture of the cost of producing a plant as it does not take into account the time value of money from planting until harvest. The analyses do, however, give a reliable estimate of the annual cost per salable plant based upon the study's assumptions.

Total annual production costs consist of both fixed and variable factors. Fixed costs are primarily made up of implicit costs such as depreciation on buildings and equipment, interest charges (both for borrowed and equity capital), and charges for

management. Many nurserymen do not adequately consider fixed costs when computing costs of production. Fixed items are often considered as residual claimants on income. For example, management is compensated if all other factors of production have been paid and there is still a residual. As noted previously, annual fixed costs are discussed in greater detail in a companion article.

Variable costs include all cost factors that vary with the quantity of plants being grown at one point in time. Variable costs are explicit, obvious, and normally paid out yearly. An example of variable costs would be the liners purchased for tree production. Two costs compose the total for purchased liners. The major cost is the purchase price. While price is somewhat dependent upon quality and quantity, it was assumed that sufficient quantity would be ordered in either sized nursery to obtain them at the lowest possible cost. The second cost was for packing and shipping the liner from producer to purchaser. This was estimated at 10% of the purchase price. Variable costs were subdivided into the following categories: propagation, materials, machinery and equipment, labor, and interest on operating capital (Tables 1 and 2). Details on specific variable costs, other than liners, are included in the companion article on rapid-growing evergreens (page).

RESULTS AND DISCUSSION

Annual fixed, variable, and total production costs of

producing field grown ornamental trees (Malus) in Ohio for 1985 are summarized in Table 3. In the 50-acre nursery, total annual costs were $100,584 or $36.82 per salable 5-6 foot tall trees. Fixed costs totaled $46,902 or $17.16 per plant and made up 46% of total costs. Based on percentage of total costs, land and improvements made up 7%, buildings 5%, machinery and equipment 13%, general overhead 20%, and interest on general overhead, insurance, and taxes 1%. Variable costs totaled $53,682 or $19.65 per tree and made up 54% of total costs. Based on percentage of total costs, materials made up 28%, machinery and equipment 9%, labor 14%, and interest on operating capital 3%.

In the 200-acre nursery, total annual costs were $295,592 or $24.73 per salable 5-6 foot tall tree. Fixed costs totaled $88,905 or $7.43 per plant and made up 30% of total costs. Based on percentage of total costs, land and improvements made up 7%, buildings 2%, machinery and equipment 9%, general overhead 11%, and interest on general overhead, insurance, and taxes 1%. Variable costs totaled $206,687 or $17.30 per tree and made up 70% of total costs. Based on percentage of total costs, materials made up 37%, machinery and equipment 10%, labor 19%, and interest on operating capital 4%.

Total annual costs were $12.09 per tree more in the 50-acre nursery than in the 200-acre. Of this $12.09, $9.73 or 80% were made up of fixed costs. On a per item basis, the 200-acre nursery's advantages were 76 cents on land and improvements, $1.16 on buildings, $2.69 on machinery and equipment, $4.81 on

general overhead, and 31 cents on interest for general overhead, insurance, and taxes. The $2.35 difference for variable costs was $1.03 for materials, 88 cents for machinery and equipment,31 cents for labor, and 13 cents for interest on operating capital. In the nurseries analyzed, it cost 33% less to produce a 5-6 foot tall ornamental tree (Malus) in the 200-acre nursery than in the 50-acre. While the overall reduction was 33%, it was 57% for fixed costs and only 12% for variable. Large-sized commercial field nurseries are able to make more efficient use of buildings, equipment, machinery, labor, and general overhead than is the case for small field nurseries.

One note of caution should be observed in comparing costs between the two sized nurseries. Each of the nurseries were analyzed based on the assumption that they would produce a diverse line of plants that included both shrubs and trees. This assumption might be unrealistic for the 50-acre nursery as a considerable amount of specialized equipment was required. It should also be noted that many operators of smaller nurseries might choose a different line of equipment than that budgeted. While the equipment budgeted is labor saving, smaller nurserymen might have a surplus of family labor and thus choose less expensive, less labor-saving equipment. Also, a small nursery might well operate its office out of a home.

Individual nurserymen might well experience, or at least calculate, costs differently from those depicted here. Most cost differences would probably be reflected in fixed rather than

variable costs. Most fixed costs are implicit and their full impact may not be calculated by established nurserymen. Budgets presented assumed new facilities, machinery, and equipment. Most nurserymen have owned their land for many years and have old machinery and equipment. For the established nursery, budgeted fixed costs on land improvements, buildings, machinery, and equipment presented here would reflect replacement rather than 'book' value of depreciated items. Presented fixed costs also assigned a market value to management. Many nurserymen place little if any value on their own management when computing costs. Variable items, on the other hand, are explicit, experienced at least yearly, and easily accounted for. Variable costs presented here would be typical for the industry in Ohio and should be rather consistent regardless of age and size of the nursery.

IMPLICATIONS

Total annual costs per 5-6 foot tall salable ornamental tree (Malus) were $36.82 in the 50-acre field nursery and $24.73 in the 200-acre field nursery. Fixed costs were $17.16 in the 50-acre nursery and $7.43 in the 200-acre for a differential of $9.73 per salable plant. Variable costs were $19.65 in the 50-acre and $17.30 in the 200-acre for a differential of $2.35. These plant costs assumed planting purchased liners directly in the field and field growing for three years, ball and burlapped harvesting, and an average size of 5-6 feet high per salable tree.

These figures demonstrated that variable costs on a salable plant basis, over the size range of nurseries analyzed, had a moderate reduction of about 12% when going from a 50-acre nursery to a 200-acre. This reduction was primarily accounted for by efficiencies gained in materials, and machinery and equipment. Fixed costs, on the other hand, had a substantial reduction of about 57% as size of nursery was increased . This occurred because most of the fixed factors required to operate the 50-acre nursery, such as management, buildings, and most machinery and equipment, were also adequate to operate the 200-acre. As the size of nursery increased, costs for fixed items of production were spread over more salable units, thereby reducing the fixed cost per plant.

LITERATURE CITED

1. Taylor, Reed D., Harold H. Kneen, Elton M. Smith, David E. Hahn, and Stanley Uchida. 1986. Costs of Establishing and Operating Field Nurseries Differentiated by Size of Firm and Species of Plant in U.S.D.A. Plant Hardiness Zones
2. Ornamental Palnts--1987: A Summary of Research. Ohio Agr. Res. and Dev. Ctr. Circ. 291, Jan. 1987.

TABLE 1.--Variable Costs (Dollars) for Ornamental Trees (Malus) for a 50-Acre* Field Nursery in Ohio, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Materials					
Burlap	54" x 54" squares + 18" basket	each	2.53	2,732.00	6,912
Twine	Nails + twine	each	0.15	2,732.00	410
Liners	5'-6' 2 yr. branched	each	6.00	3,036.00	18,216
Strip tags	5/8" X 7" plastic strip tag	each	0.02	2,732.00	55
Poultry wire	1" poultry wire for rabbit control	roll	29.00	2.00	58
Seed	Rye grass (Kentucky 31)	pound	0.64	435.60	279
Chemicals	Custom spread, custom blend: 45-0-0 0-44-0, 0-0-60 (fertilizer)	ton	176.00	1.13	199
	Custom spread, (lime)	ton	20.00	2.00	40
	Urea, 45-0-0 (fertilizer)	ton	220.00	0.66	145
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	0.50	17
	Simazine 80WP (Princep) (herbicide)	pound	3.75	15.00	56
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	44.10	281
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	13.50	247
	Benomyl, 50WP, (Benlate) (fungicide)	pound	14.17	9.50	135
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	22.50	137
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)****				260
Subtotal					27,447
Machinery and Equipment					
	Tractor, 100 HP	hour	17.00	68.48	1,164
	Tractor, 60 HP	hour	11.68	17.06	199
	Tractor, 34 HP	hour	4.99	41.78	208
	Articulated Loader/3,000lbs	hour	14.81	92.10	1,364
	Tree spade	hour	5.30	102.57	544
	Forks	hour	0.01	92.10	1
	Plow, 3-14"	hour	6.57	1.60	11
	Disk, 8' wide	hour	4.23	3.24	14
	Harrow, 10' wide	hour	8.45	0.24	2
	Cultimulcher, 10' wide	hour	24.70	0.49	12
	Spray rig with 10' boom	hour	2.77	2.46	7
	Transplanter, one row (tree)	hour	0.92	55.20	51
	Permanent irrigation\ well & pump 100HP	hour	7.60	16.00	122
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Inground irrigation - bed/field	hour	3.13	4.00	13
	Traveler gun	hour	12.06	4.00	48
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	18.00	18
	Seeder	hour	1.05	1.02	1
	Mower	hour	2.98	4.08	12
	Sidedresser, 2 row	hour	0.63	3.60	2
	Cultivator, 2 row	hour	0.95	3.96	4
	Wagon, 4 wheel	hour	0.48	8.16	4
	Truck, 1/2 ton pickup	hour	8.42	346.67	2,919
	Flatbed truck, 24' bed	hour	14.87	157.77	2,346
Subtotal					9,267

Table 1 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Labor					
	Labor hours	hour	6.93 ***	1,674.91	11,607
	Related labor hours, 20%	hour	6.93	335.00	2,322
Subtotal					13,929
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	50,643.00	3,039
Total Variable Costs					53,682
Variable Cost per Salable Plant (1 1/2" caliper)	Units available for sale in a given year	each		2,732.00	19.65

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc. Ornamental Trees - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc., 2,732, 2 inch caliper salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

****To achieve better pest and disease control, alternative chemical useage is advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 2.--Variable Costs (Dollars) for Ornamental Trees (Malus) for a 200 Acre* Field Nursery in Ohio, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Materials					
Burlap	54" x 54" squares + 18" baskets	each	2.53	11,954.00	30,244
Twine	Nails + twine	each	.15	11,954.00	1,793
Liners	5-6' 2 yr branched	each	4.86	13,283.00	64,555
Strip tags	5/8" X 7" plastic strip tag	each	0.02	11,954.00	239
Poultry wire	1" for rabbit control	roll	29.00	9.00	261
Seed	Rye grass (Kentucky 31)	pound	0.64	1,905.75	1,220
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	4.94	869
	Custom spread, (lime)	ton	20.00	8.75	175
	Urea, 45-0-0 (fertilizer)	ton	220.00	3.85	847
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	8.75	293
	Simazine 80WP (Princep) (herbicide)	pound	3.75	87.50	328
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	245.00	1,561
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	78.75	1,440
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	131.25	1,860
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	52.50	320
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)****				1,810
Subtotal					107,815
Machinery and Equipment					
	Tractor, 100 HP	hour	17.00	248.51	4,225
	Tractor, 60 HP	hour	11.68	252.38	2,948
	Tractor, 34 HP	hour	4.99	102.65	512
	Articulated loader/2,000lbs	hour	6.67	157.26	1,049
	Articulated loader/3,000lbs	hour	14.81	157.87	2,338
	Tree spade	hour	5.30	475.16	2,518
	Forks	hour	0.01	314.52	3
	Plow, 3-14"	hour	6.57	7.00	46
	Disk, 8' wide	hour	4.23	14.18	60
	Harrow, 10' wide	hour	8.45	1.05	9
	Cultimulcher, 10' wide	hour	24.70	2.02	50
	Spray rig with 10' boom	hour	2.77	13.76	38
	Transplanter, one row (tree)	hour	0.92	241.51	222
	Permanent irrigation\ well & pump 100HP	hour	7.60	29.50	224
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Inground irrigation - bed/field	hour	3.13	17.50	55
	Traveler gun	hour	12.06	17.50	211
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	78.75	80
	Seeder	hour	1.05	5.96	6
	Mower	hour	2.98	23.80	71
	Sidedresser, 2 row	hour	0.63	15.70	10
	Cultivator, 2 row	hour	0.95	17.34	16
	Wagon, 4 wheel	hour	0.48	38.34	18
	Truck, 1/2 ton pickup	hour	8.42	520.00	4,378
	Flatbed truck, 24' bed	hour	14.87	716.67	10,657
Subtotal					29,945

Table 2 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Labor					
	Labor hours	hour	6.93 ***	6,881.83	47,691
	Related labor hours, 20%	hour	6.93	1,376.00	9,537
Subtotal					57,228
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	194,988.00	11,699
Total Variable Costs					206,687
Variable Cost per Salable Plant (1 1/2" caliper)	Units available for sale in a given year	each		11,954.00	17.29

*Total Nursery - 200 acres, 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc. Ornamental Trees - 40 acres, 34 acres of growing space, 6 acres production facilities, holding & field bed area, roads, etc., 11,954, 5-6' (1 1/2") salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

****To achieve better pest and disease control, alternative chemical useage is advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

Table 3.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) of Producing Ornamental Trees (Malus) in the Field in Ohio, 1985.

Item	50 Acre Field Nursery*			200 Acre Field Nursery**		
	Cost	Cost per Salable Plant	Percent of Total Cost	Cost	Cost per Salable Plant	Percent of Total Cost
Fixed Cost Items						
Land and Improvements	7,061	2.58	(7)	21,716	1.82	(7)
Buildings	4,740	1.73	(5)	6,811	0.57	(2)
Machinery and Equipment	13,173	4.82	(13)	25,495	2.13	(9)
General Overhead	20,592	7.54	(20)	32,685	2.73	(11)
Interest on General Overhead, Insurance, and Taxes	1,336	0.49	(1)	2,198	0.18	(1)
Subtotal	46,902	17.16	(46)	88,905	7.43	30
Variable Cost Items						
Propagation	***	***	***	***	***	***
Materials	27,447	10.05	(28)	107,815	9.02	(37)
Machinery and Equipment	9,267	3.39	(9)	29,945	2.51	(10)
Labor	13,929	5.10	(14)	57,228	4.79	(19)
Interest on Operating Capital	3,039	1.11	(3)	11,699	0.98	(4)
Subtotal	53,682	19.65	(54)	206,687	17.30	(70)
Total Annual Costs	100,584	36.82	(100)	295,592	24.73	(100)

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc.
Ornamental Trees - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc.
**Total Nursery - 200 acres, 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc.
Ornamental Trees - 40 acres, 35 acres of growing space, 5 acres production facilities, holding & field bed area, roads, etc.
***Tree liners were purchased rather than propagated. Liner costs were included under materials.